

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
3 May 2001 (03.05.2001)

PCT

(10) International Publication Number
WO 01/31432 A1

(51) International Patent Classification⁷: G06F 3/12

(21) International Application Number: PCT/US00/29058

(22) International Filing Date: 19 October 2000 (19.10.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/160,414 19 October 1999 (19.10.1999) US

(71) Applicant: **ELECTRONICS FOR IMAGING, INC.**
[US/US]; 303 Velocity Way, Foster City, CA 94404 (US).

(72) Inventors: **MOTAMED, Margaret**; 208 Puffin Court,
Foster City, CA 94404 (US). **SOMESHWAR, Ravi**;
26 Barcelona Circle, Redwood City, CA 94065 (US).
GUNTURU, Ravindranath; 36857 C Newark Boulevard,
Newark, CA 94560 (US).

(74) Agents: **GLENN, Michael et al.**; Glenn Patent Group,
3475 Edison Way, Ste. L., Menlo Park, CA 94025 (US).

(81) Designated States (*national*): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

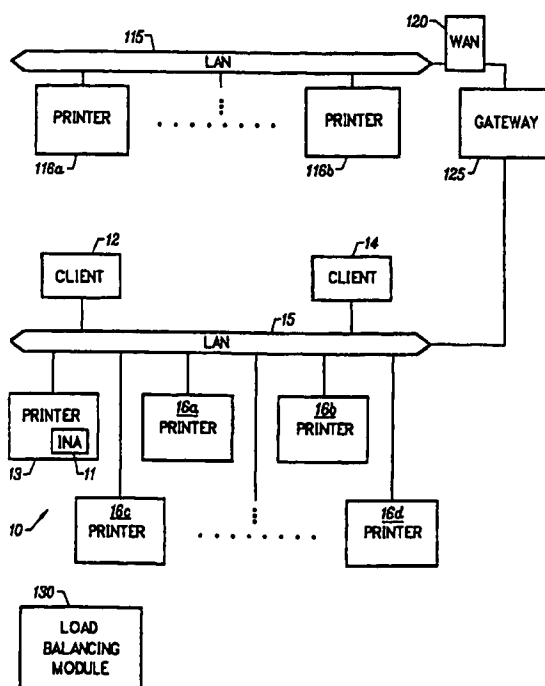
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

- With international search report.
- Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **AUTOMATIC PRINT LOAD BALANCING**



(57) Abstract: The apparatuses and methods described herein implement a novel and unique facility that decrease the time taken to perform a print job. This is accomplished by print load balancing, cluster printing and color, black-and-white page splitting. The print load balancing consists of several aspects. One aspect is to route print jobs to the most available printer based on factors such as color, black-and-white printing, printing page per minute rates, the number of pages in a job, size and number of copies in a job. Another aspect is to split the printing over more than one printer where there are several copies to be made. Yet another aspect is to split the printing over more than one printer for a single copy. Cluster printing consists of specifying a group of printers from which a print job can be performed. Color/black-and-white page splitting consists of splitting a printer job, sending non-color pages to black-and-white printers and sending pages with color, to color printers.

WO 01/31432 A1

AUTOMATIC PRINT LOAD BALANCING

BACKGROUND OF THE INVENTION

5

TECHNICAL FIELD

The invention relates to printing. More particularly, the invention relates to an apparatus and to a family of methods which reduces print times by using
10 cluster printing, print load balancing and color and black-and-white page splitting.

DESCRIPTION OF THE PRIOR ART

15 Prior art attempts to reduce the time it takes to complete a print job have focused mainly on improving hardware performance. No prior art has attempted to reduce print times by dividing a print job across all available resources.

20 Typically, a large company will occupy a large office space with a multitude of computers and printers, all networked together. The multitude of printers is acquired to handle peak periods of printing so that there will not be a slow down. However, outside of peak periods there are many idle times in which many a printer will not be in use.

25

This makes for a highly inefficient scheme because, although there are available printers, a user cannot take advantage of all of them. A user typically selects a single printer and performs the entire print job on that printer. What is needed is a method and/or apparatus that would allow the use of many or
30 all available printers to simultaneously perform a print job. In that way the total time to complete a single print job can be reduced.

SUMMARY OF THE INVENTION

- 5 The apparatuses and methods described herein implement a novel and unique facility that decrease the time taken to perform a print job. This is accomplished by print load balancing, cluster printing and color, black-and-white page splitting.
- 10 The print load balancing consists of several aspects. One aspect is to route print jobs to the most available printer based on factors such as color, black-and-white printing, printing page per minute rates, the number of pages in a job, size and number of copies in a job. Another aspect is to split the printing over more than one printer where there are several copies to be made. Yet
15 another aspect is to split the printing of page over more than one printer for a single document.

Cluster printing consists of specifying a group of printers from which a print job can be performed.

20

Color/black-and-white page splitting consists of splitting a printer job by sending non-color pages to black-and-white printers and sending pages with color, to color printers.

25

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an overall system view of a multi-user local area network system that includes several printers;

30

FIG. 2 is graphical interface window that shows the current list of selected printers;

FIG. 3 is a graphical interface window that allows the user to modify the current list of selected printers;

5 FIG. 4 is a graphical interface showing the available print groups;

FIG.5 is a graphical interface that allows a user to modify the name of a print group; and

10 FIG. 6 is a graphical interface that lists the printers assigned to a particular print group.

DESCRIPTION OF THE PREFERRED EMBODIMENT

15

The apparatuses and methods described herein implement a novel and unique facility that decrease the time taken to perform a print job. This is accomplished by print load balancing, cluster printing and color, black-and-white page splitting.

20

FIG. 1 shows an exemplary interface between multiple host computers 12 and 14 and multiple printers, generally designated by the index numerals 13, 16a, 16b, 16c, and 16d. Printer 13 includes an internal network adapter 11, located within the printer housing and the other printers also preferably include such a
25 network adapter. Network adapter 11 is connected to host computers 12 and 14 through a network, such as the local area network (LAN) 15.

Additionally, two or more LAN's 15, 115 (including additional printers 116a, 116b) may be interconnected over a WAN 120, such as the Internet, via one
30 or more gateways 125. In such configuration, a segmented network is provided. The gateway conserves WAN bandwidth by routing only those print jobs to the WAN that need to access a remote printer.

The host computers 12 and 14 can be installed in close proximity to one or more of the printers of FIG. 1, however, when operated according to the principles of the present invention, such host computers can be located quite
5 remote from these printers, as discussed above. The overall system, generally designated by the index numeral 10, can be spread in practical use on a single floor, across an entire building, or across several buildings. Each of the printers 13, 16a, 16b, 16c, and 16d, may be of the same type or of different models. Such preferred printers can be either black-and-white or
10 color printers.

A load balancing module 130 implements various inventive features discussed herein, and may be located in a single location, or may be distributed. In either event, the load balancing module may be located in a
15 printer, a client, or a gateway.

Cluster Printing

Cluster printing consists of specifying a group of printers from which a print
20 job can be performed.

A first step in this process is to identify all available printers from which a user may select printer clusters or groups from. For purposes of clarification the term printer and fiery may be used interchangeably.
25

FIG. 2 is the Edit My Printer List window 20 that shows the current list of selected printers 22 available. A user may modify this list by selecting the Modify button 24. Selecting the Modify button opens a sub-window 30 as
30 shown in FIG. 3.

One method to find available printers is by selecting the AutoSearch tab 32 , which starts a search across the local network for connected printers.

Selection of the Refresh button 34 causes the local network to be searched again. The user can also search for printers by selecting IP addresses that fall
5 within a user specified range (not shown). Once a printer is found its name 36 , device name 38 and IP address 31 are displayed in the available window 37. Another method is to search for the printers manually. Selecting the Manual tab 33 allows a user to search for a printer by domain name or by entering a specific IP address (not shown).

10

To make an available printer part of the printer pool 35 from which groups may be selected, a user highlights the printer in the available window 37, then presses the center button 39. The highlighted printer then moves to the printer pool 35. A user removes a printer from the printer pool list by
15 highlighting the printer and pressing the Remove button 40. The printer is then returned to the available printer list 37.

Selection of the Modify 24 button also allows the user to change a printer's name (not shown)

20

Once the printer pool is created, a user may then create print groups. Print groups are groups of printers that can be designated as the group to be load balanced to. A print group can be of any choice the user desires, but is typically created based on the spatial relationship to the user. For example, a
25 user working on the first floor of his office building would likely create a print group containing all the printers on the first floor. This would allow easy access to all the printers performing the group print job.

FIG. 4 is the Print Groups window 42 showing available print groups 44. A
30 user is able to add or remove a group by selecting the Add 46 or Remove 48 buttons respectively. Highlighting a group 41 and selection of the Edit Group button 43 opens a sub-menu as shown in FIG. 5. From this menu a user can

change the group name by entering it into the Edit Group Name box 52. A user can also select to Direct, Hold or Print in the Print To Queue box 54.

Referring again to FIG. 4; selecting the View Group button 45 opens up the Group List window 60 shown in FIG. 6. This window lists the printers 62 assigned to that group. Selecting the Edit Group Name button 64 opens the Edit Group 50 window as previously described. Selecting the Edit Fiery Properties button 66 opens the Edit My Fiery List window 30 as previously described.

Errors often occur with printers. Thus, within a cluster of printers a user may set for automatic rerouting of a print job to another printer if the first selected printer is unable to perform a print job. A user may also specify a timeout period before the job is rerouted. In that way the user is given time to fix the problem. This is helpful when the printer problem can be easily fixed, for example where there is a paper jam or the printer is out of paper.

Print Load Balancing

Print load balancing consists of several aspects. One aspect is to route print jobs to a printer based on such factors as printing page per minute rates and the number of pages in a job. Another aspect is to split the printing over more than one printer where there are several copies or sets to be printed. Yet another aspect is to split the printing over more than one printer when a single job has a high number of pages to print.

Printing page per minute rates

The print load balancing can be set so that the printer with the fastest printing will be chosen first. If the fastest printer is unavailable or in use, then the next fastest printer will be chosen. This hierarchal process is continued until either

no printers are left or the available printers' print speed drops below a user specified threshold.

Number of Pages in a Job

5

Often it is desirable to split a single print job where the print job has high number of pages, for example 200. The user can specify the minimum number of pages a single job must be before the job is split up. Also, the user can specify the maximum number of printers the job will go to within a group.

10 For example, a 200 page document is printed on five printers. Each printer prints forty pages with one printer printing pages 1-40, a second printer printing pages 41-80, a third pages 81-120, a fourth pages 121-160 and the fifth printer printing pages 161-200.

15 Number of Copies

Where a print job has multiple copies, settings are made so that the copies or sets will print over many printers. For example, where ten copies are desired and ten printers are available, each printer will print a single copy. A user sets
20 the maximum number of printers used. If a user sets the maximum number of printers to five printers, and wishes to print ten copies, each printer will print two copies.

Color/Black-and-White Page Splitting

25

Color/black-and-white page splitting consists of splitting a printer job by sending non-color pages to black-and-white printers and sending pages with color, to color printers.

30 Choosing how the print job will be split depends on several factors. One factor is the availability of printers. Typically there are both color printers and black-

and-white printers within a printer group. Where the entire print job lacks pages with color, the print job will be sent to black-and-white printers only.

5 Likewise, where a print job has color elements on every page, the entire print job will be sent to color printers only. However, the invention may readily be used to print all pages of a job in color or in black and white; to split the job so that color pages are routed to a color printer and black and white pages are routed to a black and white printer, or to apply an auto-detect scheme.

10 Where the print job has color and non-color pages, the non-color pages will be printed on black-and-white printers, while the pages with color are printed on color printers. The pages are then merged afterwards.

Several merge methods are available to collate print jobs that are split across
15 multiple printers. One merge method is a manual method where a human person is relied upon to combine the non-color and color pages. Another method is the use of a coversheet and an external collator. The coversheet contains a machine and human readable barcode and is produced along with each print job. The coversheet contains instruction on how to merge the
20 document. The coversheet and printed pages are inserted into an external collator and the document is merged into its final format. The invention can use in-line collator. In such application, information on the cover sheet is machine readable. The invention can also use a human readable cover sheet. The cover sheet can be used to determine collation.

25

Other merge methods include letting each printer perform the collation.

Other Embodiments

30 **Priority Printing**

Several options are available to set the priority of a print job. Normally, print jobs are performed in the order they are queued. However, a user may set her print job on fastest or background. A fastest setting will move the print job to the front of the queue so that it will be printed first. If a print job is already
5 being performed, a print job with a fastest setting will start printing afterward. All other queued print jobs will be printed in the order they were queued.

A print job with a background setting will wait until all other queued print jobs are printed first. For example, if a print job with a background setting is
10 queued, it will be the last print job to be printed. If another print job is queued afterwards then that later queued print job will move ahead of the print job with the background setting. This will continue until there are no other queued print jobs. If there are two or more background print jobs, each background print job will be printed in the order in which they were queued, unless a non-
15 background print job is queued. If that happens the non-background print job will be printed before both print jobs with the background setting.

Job Scheduling

20 The user can also schedule print jobs long into the future. The user inputs the time and date she wishes the print job to be performed. When the inputted date and time arrives, the print job is performed, *e.g.* through the printer driver.

25 Accordingly, although the invention has been described in detail with reference to a particular preferred embodiment, persons possessing ordinary skill in the art to which this invention pertains will appreciate that various modifications and enhancements may be made without departing from the spirit and scope of the claims that follow.

CLAIMS

1. A method for performing a single print job between a plurality of
5 printers connected to a computer through a communication means,
comprising:
- determining with said computer through which of said plurality of printers said
print job is to be transmitted so as to balance said print job between said
10 plurality of printers based upon a load balancing scheme;
- transmitting through said communication means, said print job to said plurality
of printers based on said load balancing scheme;
- 15 printing said print job by said plurality of printers.
2. The method of claim 1 wherein said load balancing scheme divides
said print job by sets.
- 20 3. The method of claim 1 wherein said load balancing scheme divides
said print job by sending pages with no color to black-and-white printers and
sends pages with color to color capable printers.
4. The method of claim 1 wherein said load balancing scheme divides
25 said print job by page number.
5. The method of claim 1 wherein said plurality of printers is user defined.
6. The method of claim 1 wherein a printer from said plurality of printers is
30 removed upon an error.

7. The method of claim 1 wherein said print job has a user defined priority.
8. The method of claim 7 wherein said priority puts said print job first
5 amongst all queued print jobs.
9. The method of claim 7 wherein said priority delays said print job until all other queued print jobs are performed.
10. The method of claim 7 wherein said priority queues said print job at a
10 specific date and time.
11. The method of Claim 7 wherein said user defined priority is a print speed threshold.
15
12. The method of Claim 1 wherein a print job is rerouted in the event of printer error based upon factors which may include any of the state of any or all eligible printers, the type of error, user defined, and interactive options.
13. An apparatus for performing a single print job between a plurality of
20 printers connected to a computer through a communication means, comprising:
- a module for determining with said computer through which of said plurality of
25 printers said print job is to be transmitted so as to balance said print job between said plurality of printers based upon a load balancing scheme;
- a module for transmitting through said communication means, said print job to said plurality of printers based on said load balancing scheme;
- 30 a module for printing said print job by said plurality of printers.

14. The apparatus of claim 13 wherein said load balancing scheme divides said print job by sets.
15. The apparatus of claim 13 wherein said load balancing scheme divides
5 said print job by sending pages with no color to black-and-white printers and sends pages with color to color capable printers.
16. The apparatus of claim 13 wherein said load balancing scheme divides said print job by page number.
- 10 17. The apparatus of claim 13 wherein said plurality of printers is user defined.
18. The apparatus of claim 13 wherein a printer from said plurality of
15 printers is removed upon an error.
19. The apparatus of claim 13 wherein said print job has a user defined priority.
- 20 20. The apparatus of claim 13 wherein said priority puts said print job first amongst all queued print jobs.
21. The apparatus of claim 13 wherein said priority delays said print job until all other queued print jobs are performed.
- 25 22. The apparatus of claim 13 wherein said priority queues said print job at a specific date and time.
23. The apparatus of Claim 19 wherein said user defined priority is a print
30 speed threshold.
24. The apparatus of Claim 13 wherein a print job is rerouted in the event

of printer error based upon factors which may include any of the state of any or all, printers, the type of error, user defined options, and interactive options eligible.

1/5

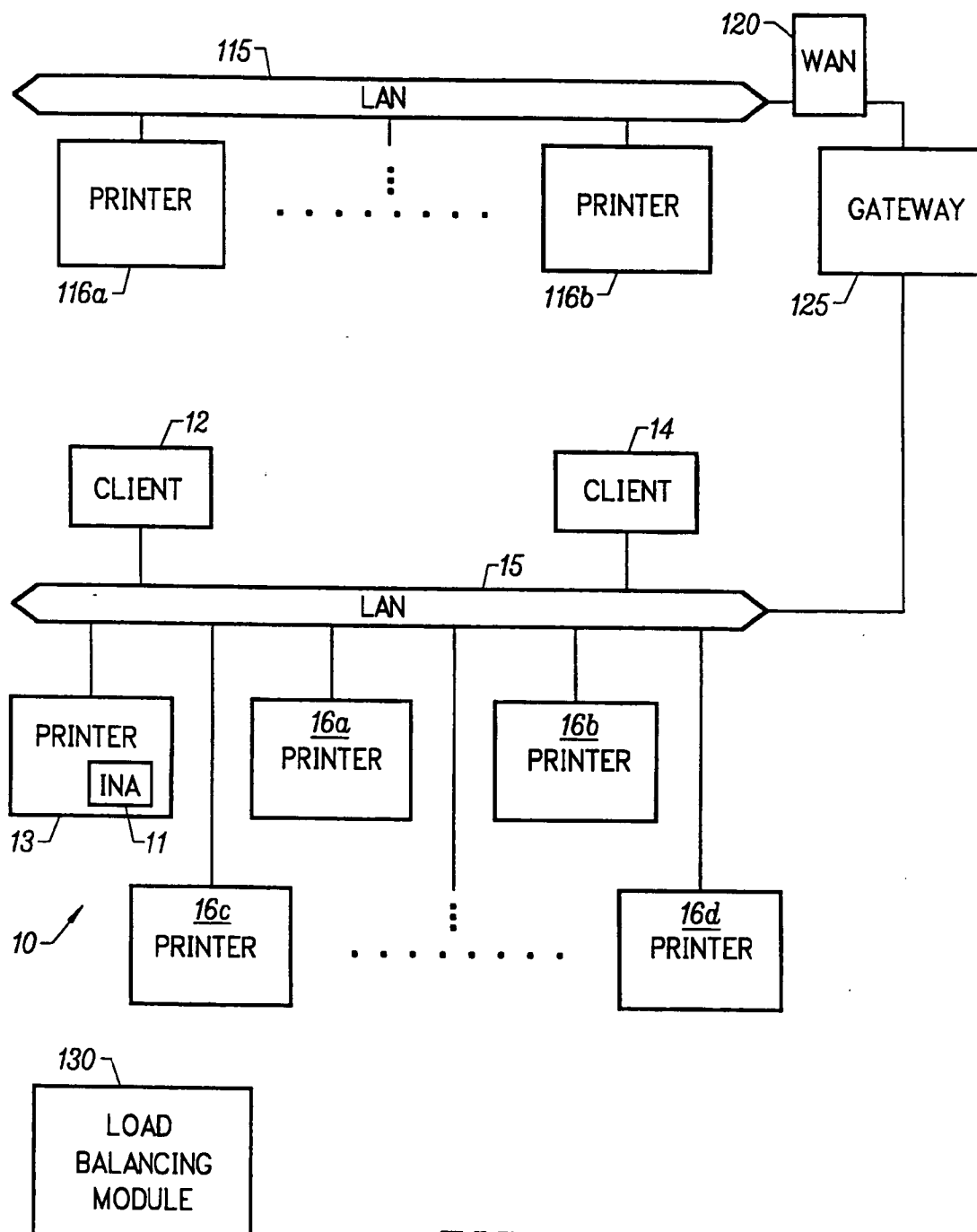


FIG. 1

2/5

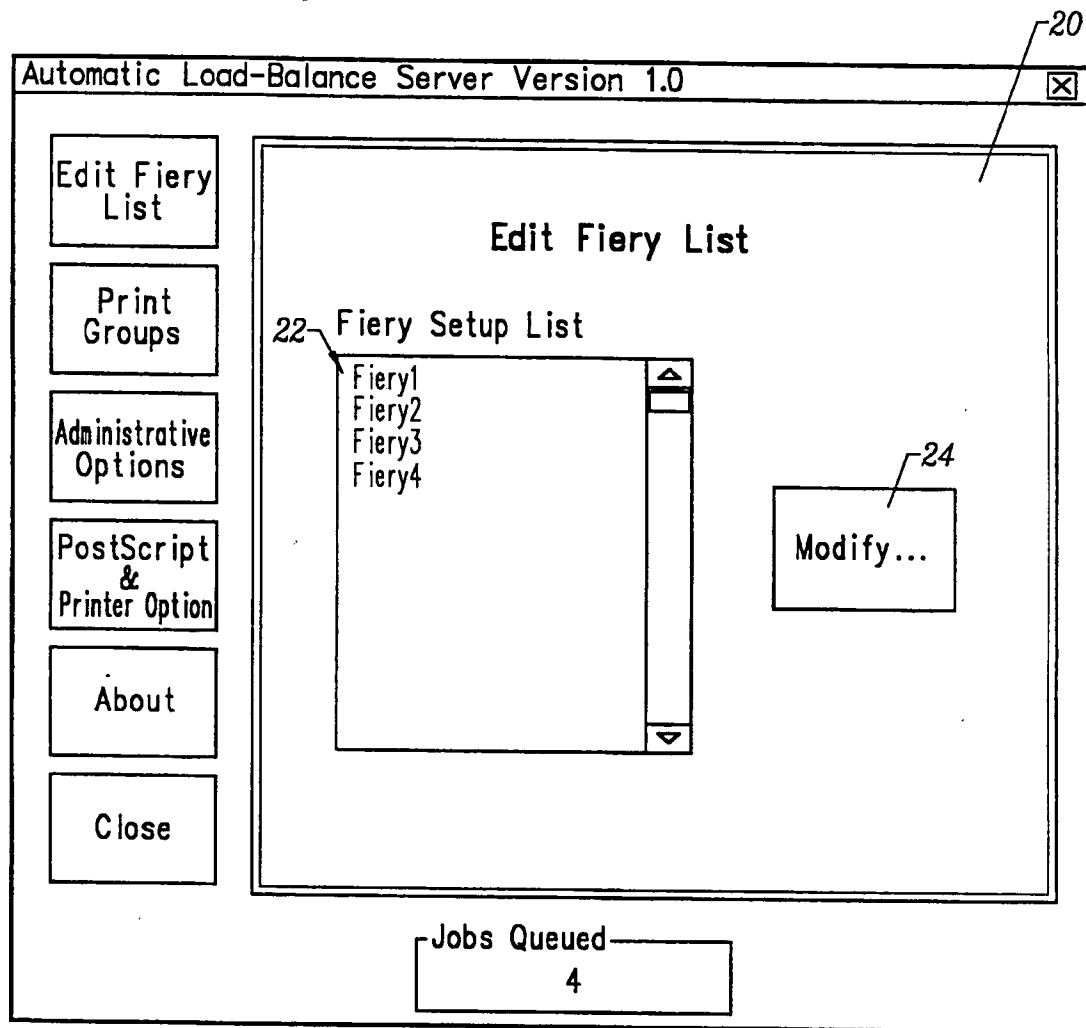


FIG. 2

3/5

The screenshot shows a window titled "Edit My Fiery List" with a close button in the top right corner. Inside the window, there is a section with "AutoSearch" and "Manual" buttons. Below this is a section labeled "Available Fierys" containing "Refresh" and "Advanced" buttons. A table with three columns: "Name", "Device Name", and "IP-Address" is shown, with one row containing "Fiery1", "Engine1", and "10.10.78.17". Below the table is a dropdown arrow. Another section labeled "My Fiery List" contains a table with the same three columns and three rows: "Fiery2" with "Engine2" and "10.11.143.56", and "Fiery3" with "Engine3" and "10.10.78.25". Below this table are "Modify..." and "Remove" buttons. At the bottom of the window are "OK", "Cancel", and "Apply" buttons.

30

32

AutoSearch Manual

33

34

Available Fierys Refresh Advanced

36

Name	Device Name	IP-Address
Fiery1	Engine1	10.10.78.17

38

31

37

39

My Fiery List

Name	Device Name	IP-Address
Fiery2	Engine2	10.11.143.56
Fiery3	Engine3	10.10.78.25

35

40

Modify... Remove

OK Cancel Apply

FIG. 3

4/5

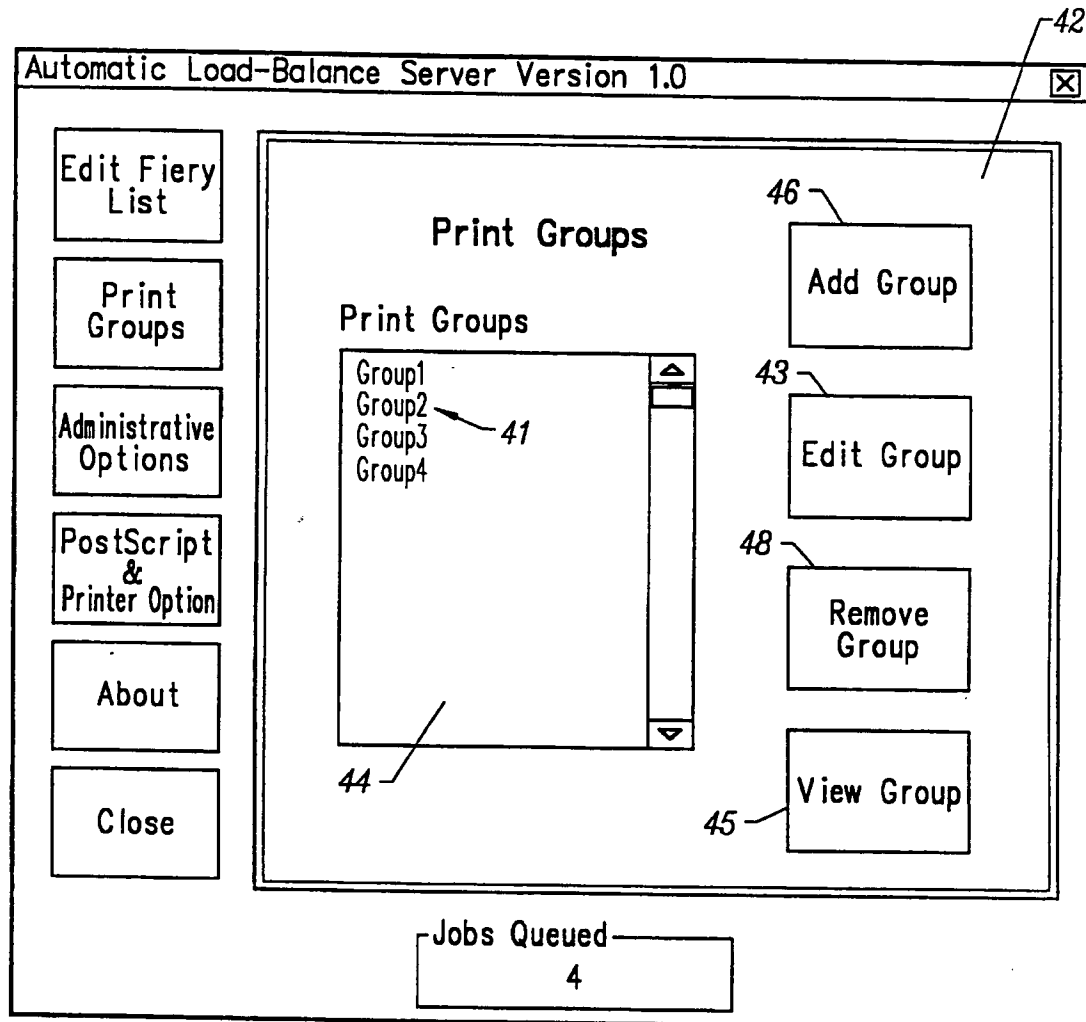


FIG. 4

5/5

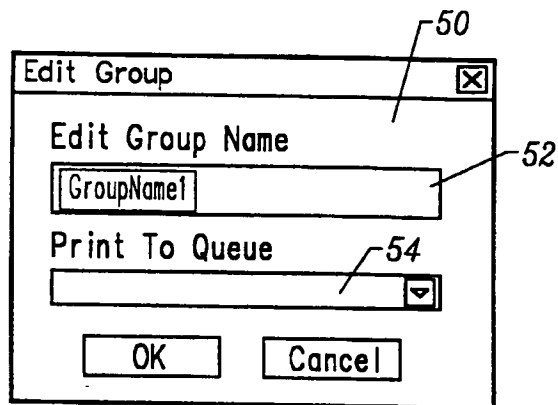


FIG. 5

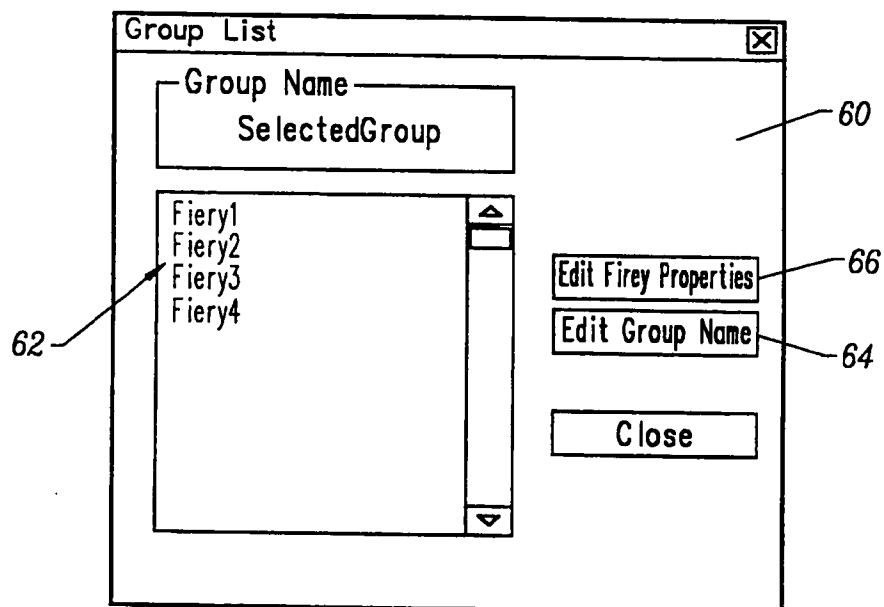


FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/29058

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06F3/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G06F G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 917 044 A (XEROX CORP) 19 May 1999 (1999-05-19) figures 1-3 column 2, line 43 -column 7, line 33	1,2,4,5, 7,11,13, 14,16, 17,19,23
X	EP 0 729 090 A (OCE NEDERLAND BV) 28 August 1996 (1996-08-28) the whole document	1-5,11, 13-17, 19,23

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

6 March 2001

Date of mailing of the international search report

15/03/2001

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax (+31-70) 340-3016

Authorized officer

Weiss, P

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/29058

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0917044 A	19-05-1999	US 5978560 A	02-11-1999
EP 0729090 A	28-08-1996	JP 8286858 A	01-11-1996